

Notice of Allowability

Application No.

10/074,561

Examiner

Zandra V. Smith

Applicant(s)

SEZGINER ET AL.

Art Unit

2877

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to amendment filed 8 March 2004.
2. ☒ The allowed claim(s) is/are 3-10, 12-15, 19, 21-34, 37-40 and 1717.
3. ☒ The drawings filed on 12 February 2002 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

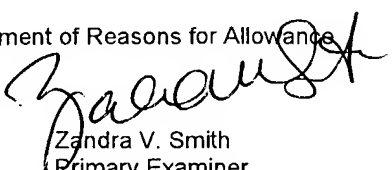
5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date 8 March 2004
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material

5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413),
Paper No./Mail Date _____
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____


Zandra V. Smith
Primary Examiner
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EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Jason Lohr on 12 May 2004.

The application has been amended as follows:

10. (Currently Amended) A method of measuring alignment accuracy between two or more patterned layers formed on a substrate comprising:

forming test areas as part of the patterned layers, wherein a first diffraction grating is built into a patterned layer A and a second diffraction grating is built into a patterned layer B, where layers A and B are desired to be aligned with respect to each other, zero or more layers of other materials separating layers A and B, the two gratings substantially overlapping when viewed from a direction that is perpendicular to the surfaces of A and B,

observing the overlaid diffraction gratings using an optical instrument capable of measuring any one or more of transmission, reflectance, or ellipsometric parameters as a function of any one or more of wavelength, polar angle of incidence, azimuthal angle of incidence, or polarization of the illumination and detection; and

determining the offset between the gratings from the measurements from the optical instrument using an optical model, wherein the optical model accounts for the diffraction

of the electromagnetic waves by the gratings and the interaction of the gratings with each other's diffracted field;

wherein at least one of the two gratings contains more than one line per pitch, the widths of the at least two lines in each pitch (~~unit cell~~) being substantially different from each other.

18. (Currently Amended) An apparatus for determining overlay error between two or more patterned layers of a sample comprising:

a metrology target comprising a first diffraction grating built into a patterned layer A and second diffraction grating built into a patterned layer B, where layers A and B are part of the sample under test and layers A and B are desired to be aligned with respect to each other, the two gratings substantially overlapping when viewed from a direction that is perpendicular to the layers A and B;

an optical instrument that illuminates part or all of the metrology target and that measures properties of light that has interacted with the metrology target as a function of any one or more of polar angle of incidence, azimuthal angle of incidence, and polarization of the illumination and detection; and

a processor which estimates the offset of the grating pair from the measured properties;

wherein at least one of the two gratings contains more than one line per pitch, the widths of the at least two lines in each pitch (~~unit cell~~) being substantially different from each other.

Allowable Subject Matter

Claims 3-10, 12-15, 17-19, 21-34, and 37-40

The following is an examiner's statement of reasons for allowance: the prior art of record, taken alone or in combination, fails to disclose or render obvious, method of and apparatus for measuring alignment accuracy between two or more patterned layers formed on a substrate that includes an opaque layer between the grating patterns in layer A and the grating patterns in layer B, along with the rest of the limitations of claims 3 and 19.

Regarding claim 4, the prior art of record, taken alone or in combination, fails to disclose or render obvious, method of measuring alignment accuracy between two or more patterned layers formed on a substrate that includes determining the offset between gratings using an optical model, wherein the optical model represents the electromagnetic field in the grating and in the layers between gratings as a sum of more than one diffracted orders, in combination with the rest of the limitations of claim 4.

As to claims 5 and 21, the prior art of record, taken alone or in combination, fails to disclose or render obvious, method of and apparatus for measuring alignment accuracy between two or more patterned layers formed on a substrate that includes calculating, according to a model of a wafer sample, the optical response of the sample with the said two overlapping gratings, the model of the sample taking into account parameters of the sample including any of the overlay misalignment of layers A and B, the profiles of the grating structures, and asymmetries caused in the grating structures by manufacturing processes;

changing the parameters of the sample model to minimize the difference between the calculated and measured optical responses, and

repeating the previous two steps until the difference between the calculated and measured optical responses is sufficiently small or cannot be significantly decreased by further iterations, in combination with the rest of the limitations of claims 5 and 21.

As to claims 9 and 17, the prior art of record, taken alone or in combination, fails to disclose or render obvious, method of and apparatus for measuring alignment accuracy between two or more patterned layers formed on a substrate that includes first and second diffraction gratings having different pitches, in combination with the rest of the limitations of the claims.

As to claims 10 and 18, the prior art of record, taken alone or in combination, fails to disclose or render obvious method of and apparatus for measuring alignment accuracy between two or more patterned layers formed on a substrate that includes first and second diffraction gratings on different layers wherein at least one of the two gratings contains more than one line per pitch, the widths of the at least two lines in each pitch being substantially different from each other, in combination with the rest of the limitations of the claims.

Regarding claim 12, the prior art of record, taken alone or in combination, fails to disclose or render obvious a method of determining a degree of registration between an upper layer and a lower layer formed on a substrate that includes monitoring the zeroth-order light diffracted from the layers, generating a parameterized model representing the geometry and registration of parameters of the model and comparing the predicted optical response with the monitored zeroth-order light, in combination with the rest of the limitations of the claim.

As to claim 24, the prior art of record, taken alone or in combination, fails to disclose or render obvious apparatus for measuring alignment accuracy between two or more patterned layers formed on a substrate that includes an ellipsometer that illuminates part or all of the

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metrology target to measure properties of light that has interacted with the metrology target and a processor which estimates the offset of the grating pair from the pair's measured optical characteristics, in combination with the rest of the limitations of the claim.

As to claims 34 and 37, the prior art of record, taken alone or in combination, fails to disclose or render obvious method of and apparatus for measuring alignment accuracy between two or more patterned layers formed on a substrate that includes a second test area having a pattern built into layers A and B, wherein the pattern in the second areas comprises a bar-in-bar pattern, in combination with the rest of the limitations of the claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

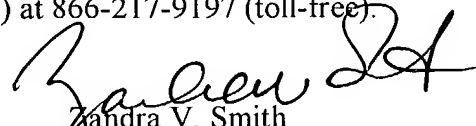
Fax/Telephone Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Zandra V. Smith whose telephone number is (571) 272-2429. The examiner can normally be reached on 8:00 a.m. - 4:30 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank G. Font can be reached on (571) 272-2415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Zandra V. Smith
Primary Examiner
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May 12, 2004